

## 5 WE CLAIM:

1. Process for the preparation of zinc alkyl chain growth products via a catalysed chain growth reaction of an alpha-olefin on a zinc alkyl, comprising contacting the zinc alkyl with a chain growth catalyst system which employs a group 3-10 transition metal,  
10 or a group 3 main group metal, or a lanthanide or actinide complex, and optionally a suitable activator.
2. Process for the preparation of alpha-olefins, comprising performing the process of claim 1, followed by olefin displacement of the grown alkyls as alpha-olefins from the  
15 zinc alkyl chain growth product.
3. Process for the preparation of primary alcohols, comprising performing the process of claim 2, followed by oxidation of the resulting zinc alkyl chain growth product to form alkoxide compounds, followed by hydrolysis of the alkoxides to  
20 produce primary alcohols.
4. Process according to claim 1, wherein the zinc alkyl compound comprises a species or mixture of species containing a  $R'R''CH-Zn$  or  $R'R''C-Zn$  moiety, where  $R'$  and  $R''$  are independently selected from hydrogen, hydrocarbyl, silyl,  
25 and substituted hydrocarbyl, and may be linked to form a cyclic species, subject to the proviso that in the case of  $R'R''C-Zn$ , the C bonded to the Zn is unsaturated.
5. Process according to claim 1, wherein the zinc alkyl compound has the formula  $R_mZnH_n$  where m is 1 or 2 and n is 0 or 1,  $m+n=2$ , and each R is independently  $C_1$  to  
30  $C_{30}$  alkyl.
6. Process according to claim 1, wherein the zinc alkyl compound is selected from dimethylzinc, diethylzinc, di-n-butylzinc, di-n-hexylzinc, dibenzylzinc, di-n-decylzinc, di-n-dodecylzinc, di-phenyl-Zn and  $(C_5H_5)ZnEt$ .

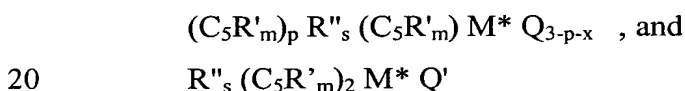
35

7. Process according to claim 1, wherein the alpha-olefin is selected from C<sub>2</sub> to C<sub>16</sub> linear alpha-olefins.

8. Process according to claim 1, wherein the chain growth catalyst system comprises a metallocene, which may contain at least one cyclopentadienyl-based ring ligand.

9. Process according to claim 8, wherein the chain metallocene catalyst component is represented by the general formula (C<sub>p</sub>)<sub>m</sub> MR<sub>n</sub>R'<sub>p</sub> wherein at least one C<sub>p</sub> is selected from an unsubstituted or substituted cyclopentadienyl ring, a substituted or unsubstituted ring system such as an indenyl moiety, a benzindenyl moiety, a fluorenyl moiety, and any other ligand capable of η-5 bonding; M is selected from a Group 4, 5 or 6 transition metal, a lanthanide or an actinide; R and R' are independently selected from halogen, a hydrocarbyl group, and a hydrocarboxyl group having 1-20 carbon atoms or combinations thereof; m=1-3, n=0-3, p=0-3, and the sum of m+n+p equals the oxidation state of M.

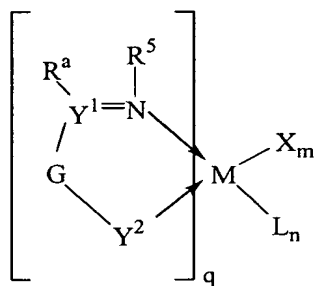
10. Process according to claim 8, wherein the chain metallocene catalyst component is selected from the formulas:



wherein M\* is a Group 4, 5 or 6 transition metal, a lanthanide or an actinide; at least one C<sub>5</sub>R'<sub>m</sub> is a substituted cyclopentadienyl; each R', which can be the same or different is hydrogen, or an alkyl, alkenyl, aryl, alkylaryl or arylalkyl radical having from 1 to 20 carbon atoms or two carbon atoms joined together to form a part of a substituted or unsubstituted ring or rings having 4 to 20 carbon atoms; R'' is at least one C-, Ge-, Si-, P- or N-containing radical either bridging two (C<sub>5</sub>R'<sub>m</sub>) rings or bridging one (C<sub>5</sub>R'<sub>m</sub>) ring and M\*; each Q, which can be the same or different, is selected from an aryl, alkyl, alkenyl, alkylaryl, or arylalkyl radical having from 1 to 20 carbon atoms, halogen, or alkoxides; Q' is an alkylidene radical having from 1-20 carbon atoms; s is 0 or 1 and when s is 0, m is 5 and p is 0, 1 or 2, and when s is 1, m is 4 and p is 1; when p=0, x=1 otherwise "x" is always equal to 0.

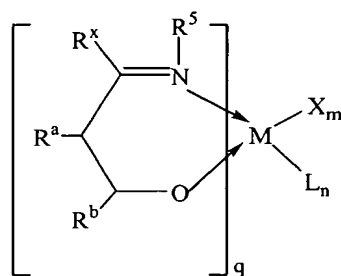
11. Process according to claim 8, wherein the chain metallocene catalyst component is selected from bis(pentamethylcyclopentadienyl) zirconium dichloride, bis(pentamethylcyclopentadienyl) hafnium dichloride, bis(tetramethylcyclopentadienyl) zirconium dichloride, (pentamethylcyclopentadienyl) zirconium trichloride, (tetramethylcyclopentadienyl)(t-butylamido)(dimethylsilane) titanium dimethyl, and (pentamethylcyclopentadienyl)(cyclopentadienyl) zirconium dichloride.

12. Process according to claim 1, wherein the chain growth catalyst system comprises a complex of the Formula (I):



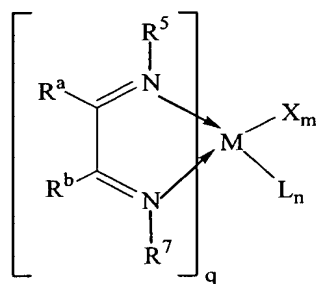
wherein M is Y[II], Y[III], Sc[II], Sc[III], Ti[II], Ti[III], Ti[IV], Zr[III], Zr[IV], Hf[II], Hf[III], Hf[IV], V[II], V[III], V[IV], Nb[II], Nb[III], Nb[IV], Nb[V], Ta[II], Ta[III], Ta[IV], Cr[II], Cr[III], Mn[II], Mn[III], Mn[IV], Fe[II], Fe[III], Ru[II], Ru[III], Ru[IV], Co[II], Co[III], Rh[II], Rh[III], Ni[II], Pd[II], X represents an atom or group covalently or ionically bonded to the transition metal M; Y<sup>1</sup> is C or P(R<sup>c</sup>); Y<sup>2</sup> is -O(R<sup>7</sup>), -O (in which case the bond from O to M is covalent), -C(R<sup>b</sup>)=O, -C(R<sup>b</sup>)=N(R<sup>7</sup>), -P(R<sup>b</sup>)(R<sup>d</sup>)=N(R<sup>7</sup>) or -P(R<sup>b</sup>)(R<sup>d</sup>)=O; R<sup>a</sup>, R<sup>b</sup>, R<sup>c</sup>, R<sup>d</sup>, R<sup>5</sup> and R<sup>7</sup> are each independently selected from hydrogen, halogen, hydrocarbyl, substituted hydrocarbyl, heterohydrocarbyl, substituted heterohydrocarbyl or SiR'<sub>3</sub> where each R' is independently selected from hydrogen, halogen, hydrocarbyl, substituted hydrocarbyl, heterohydrocarbyl and substituted heterohydrocarbyl, and any adjacent ones may be joined together to form a ring; G is either a direct bond between Y<sup>1</sup> and Y<sup>2</sup>, or is a bridging group, which optionally contains a third atom linked to M when q is 1; L is a group datively bound to M; n is from 0 to 5; m is 1 to 3 and q is 1 or 2.

13. Process according to claim 1, wherein the chain growth catalyst system comprises a complex of the formula (II):



wherein M is Y[II], Y[III], Sc[II], Sc[III], Ti[II], Ti[III], Ti[IV], Zr[II], Zr[III], Zr[IV], Hf[II], Hf[III], Hf[IV], V[II], V[III], V[IV], Nb[II], Nb[III], Nb[IV], Nb[V], Ta[II], Ta[III], Ta[IV], Cr[II], Cr[III], Mn[II], Mn[III], Mn[IV], Fe[II], Fe[III], Ru[II], Ru[III], Ru[IV], Co[II], Co[III], Rh[II], Rh[III], Ni[II], Pd[II], X represents an atom or group covalently or ionically bonded to the transition metal M;  $R^a$ ,  $R^b$ ,  $R^x$ , and  $R^5$  are each independently selected from hydrogen, halogen, hydrocarbyl, substituted hydrocarbyl, heterohydrocarbyl, substituted heterohydrocarbyl or  $\text{SiR}'_3$  where each  $R'$  is independently selected from hydrogen, halogen, hydrocarbyl, substituted hydrocarbyl, heterohydrocarbyl and substituted heterohydrocarbyl, and any adjacent ones may be joined together to form a ring; L is a group datively bound to M; n is from 0 to 5; m is 1 to 3 and q is 1 or 2.

14. Process according to claim 1, wherein the chain growth catalyst system comprises a complex of the Formula (III):

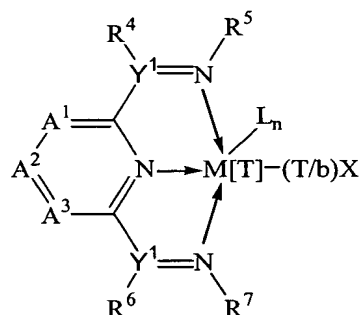


wherein M is Cr[II], Cr[III], Mn[II], Mn[III], Mn[IV], Fe[II], Fe[III], Ru[II], Ru[III], Ru[IV], Co[II], Co[III], Rh[II], Rh[III], Ni[II], Pd[II], Cu[I], Cu[II]; X represents an atom or group covalently or ionically bonded to the transition metal M;  $R^a$  and  $R^b$  are each independently selected from hydrogen, halogen, hydrocarbyl, substituted hydrocarbyl, heterohydrocarbyl, substituted heterohydrocarbyl or  $\text{SiR}'_3$  where each  $R'$  is

independently selected from hydrogen, halogen, hydrocarbyl, substituted hydrocarbyl, heterohydrocarbyl and substituted heterohydrocarbyl, and  $R^a$  and  $R^b$  may be joined together to form a ring;  $R^5$  and  $R^7$  are each as defined above; and L is a group datively bound to M; n is from 0 to 5; m is 1 to 3 and q is 1 or 2.

5

15. Process according to claim 1, wherein the chain growth catalyst system comprises a complex of the Formula (IV):



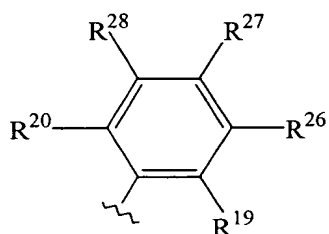
wherein M[T] is Ti[II], Ti[III], Ti[IV], Zr[II], Zr[III], Zr[IV], Hf[II], Hf[III], Hf[IV],  
 10 V[II], V[III], V[IV], Nb[II], Nb[III], Nb[IV], Nb[V], Ta[II], Ta[III], Ta[IV], Cr[II],  
 Cr[III], Mn[II], Mn[III], Mn[IV], Fe[II], Fe[III], Ru[II], Ru[III], Ru[IV], Co[II], Co[III],  
 Rh[II], Rh[III], Ni[II], Pd[II]; X represents an atom or group covalently or ionically  
 bonded to the transition metal M; T is the oxidation state of the transition metal M and b  
 is the valency of the atom or group X;  $Y^1$  is C or  $P(R^c)$ ,  $A^1$  to  $A^3$  are each independently  
 15 N or P or CR, with the proviso that at least one is CR; and R,  $R^c$ ,  $R^4$ ,  $R^5$ ,  $R^6$  and  $R^7$  are  
 each independently selected from hydrogen, halogen, hydrocarbyl, substituted  
 hydrocarbyl, heterohydrocarbyl, substituted heterohydrocarbyl or  $SiR'_3$  where each  $R'$  is  
 independently selected from hydrogen, halogen, hydrocarbyl, substituted hydrocarbyl,  
 heterohydrocarbyl and substituted heterohydrocarbyl.

20

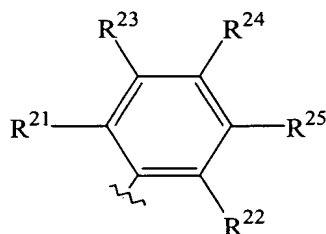
16. Process according to claim 15, wherein  $Y^1$  is C, and  $A^1$  to  $A^3$  are each  
 independently CR, or  $A^1$  and  $A^3$  are both N and  $A^2$  is CR, or one of  $A^1$  to  $A^3$  is N and  
 the others are independently CR.

25

17. Process according to claim 15, wherein  $Y^1$  is C,  $A^1$  to  $A^3$  are each independently  
 CR, and  $R^5$  is represented by the group "P" and  $R^7$  is represented by the group "Q" as  
 follows:



Group P



Group Q

wherein  $R^{19}$  to  $R^{28}$  are independently selected from hydrogen, halogen, hydrocarbyl, substituted hydrocarbyl, heterohydrocarbyl or substituted heterohydrocarbyl; when any two or more of  $R^1$  to  $R^4$ ,  $R^6$  and  $R^{19}$  to  $R^{28}$  are hydrocarbyl, substituted hydrocarbyl, heterohydrocarbyl or substituted heterohydrocarbyl, said two or more can be linked to form one or more cyclic substituents.

18. Process according to claim 1, wherein the chain growth catalyst system is selected from 2,6-diacetylpyridinebis(2,4,6 trimethyl anil)FeCl<sub>2</sub> and 2,6-diacetylpyridinebis(2, 6 diisopropyl anil)FeCl<sub>2</sub>.

19. Process according to claim 1, wherein the activator for the chain growth catalyst system is selected from organoaluminium compounds and hydrocarbylboron compounds.

20. Process according to claim 1, wherein the chain growth reaction utilises a neat zinc alkyl medium or a hydrocarbon solvent diluent.

21. Process according to claim 1, wherein the mole ratio of transition metal to zinc alkyl is between  $1 \times 10^{-7}$  and  $1 \times 10^{-1}$ .

22. Process according to claim 1, wherein the catalyst is activated by incubation in aluminoxane solution for about 5 minutes at 20°C prior to addition to the zinc alkyl.

23. Composition comprising an alkyl zinc complex wherein the alkyl groups follow a substantially Poisson-like statistical distribution of chain lengths up to about 200 carbon atoms, or a substantially Schulz-Flory-like statistical distribution of chain lengths up to about 50,000 carbon atoms.